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I, Robert A Chaney, hereby submit this original work as part of the requirements for the degree of Master of Science in Health Education.

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Active transportation prediction using Theory of Planned Behavior among college students

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Using Theory of Planned Behavior to Predict Active Transportation Among College Students

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Abstract

AN ABSTRACT OF THE THESIS FOR THE MASTER OF SCIENCE DEGREE IN HEALTH PROMOTION AND EDUCATION, PRESENTED 11 October 2012, AT THE UNIVERSITY OF CINCINNATI, OHIO.

TITLE: Using Theory of Planned Behavior to Predict Active Transportation Among College Students

MASTERS COMMITTEE MEMBERS: Dr. Amy L. Bernard (Chair) and Dr. Bradley R. A. Wilson

Rates of physical inactivity have been on the rise in America among all groups of people, including college students. Physical inactivity poses serious health risks. Active transportation (AT) is commuting under one’s own power. Examples of AT include bicycling and walking. This mode of transportation may be a helpful tool promoting physical activity. The purpose of this study was to describe predictors of active transportation behavior among University of Cincinnati students. Students were selected through the UC Registrar’s office and were emailed the survey instrument. Significant differences for all Theory of Planned Behavior constructs were seen between AT users and non-AT users except the distal construct, perceived behavioral control and its corresponding proximal constructs. A regression model predicting AT use with only Theory of Planned behavior constructs accounted for 11% of explained variation in AT use. However, when other variables were added to the regression model, 51% explanation was achieved. The final model included subjective norms, age, perceived behavioral control, and transportation type and destination. This research provides useful insight to explaining AT behavior that heretofore has not been done. Applications for this knowledge may include promoting physical activity, safety for AT users or general understanding of AT use.
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Chapter One: The Problem

Disappearing are the days when children would ride their bicycles to the market, or race around the block with the other neighborhood kids. Now appearing are the days when adults and children alike watch hours of television, surf the Internet, and engage in sedentary behaviors. America is becoming more and more sedentary (Obesity and overweight: U.S. obesity trends:2011; Vandelanotte, Sugiyama, Gardiner, & Owen, 2009). The cause for concern is that a sedentary behavior increases risk of developing a variety of diseases including obesity, diabetes and cardiovascular disease, all of which are largely preventable. Every age group and group of people is affected by physical inactivity.

Research supports that physical inactivity is a growing concern in America. It has been reported that only 22% of Americans get the recommended allotment of 150 minutes of moderate exercise per week. It was further reported that 60% of Americans are not physically active on a consistent basis, and 25% percent did not exercise at all (Centers for Disease Control and Prevention, 2012; Keim, Blanton, & Kretsch, 2004). The picture appears slightly, but not entirely better for a population traditionally considered to be among the most active groups of citizens: college students. Research reports that 40-50% of college students are not obtaining the recommended level of exercise (Keating, Guan, Piñero, & Bridges, 2005). These rates do not appear to be singular to American college students either (Leslie et al., 1999; Molina-Garcia, Castillo, & Sallis, 2010). Important determinants of exercise behavior appear to be being male and belonging to a social group that is supportive of exercise (McArthur & Raedeke, 2009).

Along with physical inactivity becoming a worsening problem in the general population, there also appears to be more barriers to PA. The most common barrier to
physical activity is lack of time (Adachi-Mejia et al., 2010; Allison, Dwyer, & Makin, 1999; Guinn & Vincent, 2008). This was commonly reported for most groups of people, which is understandably so. In a world where people feel increasingly busy and stressed, PA often gets pushed to the bottom of to-do lists. Other key barriers to PA include knowledge, motivation, resources available in the built environment, and lifestyle barriers like obesity (Cutts, Darby, Boone, & Brewis, 2009; McArthur & Raedeke, 2009; Vandelanotte, Sugiyama, Gardiner, & Owen, 2009).

Persons who lack knowledge about PA are less likely to benefit from and engage in this activity. An example of how lack of knowledge can be a barrier is not understanding resources available, such as gyms, experts, and literature. How to perform exercises and which are most health promoting is another knowledge barrier. Motivation is a common internal barrier to PA along with lacking self discipline and simply not enjoying exercise (Schwetschenau, O'Brien, Cunningham, & Jex, 2008). The undisciplined person, or one who does not enjoy PA is less likely to engage in exercise long-term. Along with knowledge and motivation, the build environment (e.g. sidewalks, parks, etc.) can promote or inhibit engagement in PA. This does not only include available parks, condition and connectivity of sidewalks, but extents to neighborhood safety and environmental conditions (Cutts, Darby, Boone, & Brewis, 2009; Wen, Balluz, Shire, Mokdad, & Kohl III, 2009). And, lastly, behavioral barriers can stand in the way of obtaining the proper PA. Examples of these include too much time watching television, on the Internet, or playing videogames.

These rates, determinants, and barriers help give insight to health consequences to being physically inactive. Sedentariness is of increasing concern in America. Individual concern for a physically inactive lifestyle includes increase risk for a variety of diseases.
Diseases for which risk is heightened by physical inactivity include chronic diseases like cardiovascular disease, obesity, and diabetes (Hart, Barreira, & Kang, 2010; Qin, Knol, & Corpelejin, 2010). The risk of cancer, including breast cancer and colon cancer, is reduced by engaging in PA as well (Kruk, 2007; Pace & Glass, 2000). Not only that, but PA tends to help people feel good; it tends to improve mental health among those who engage in it, including dampening depression, stress, and fatigue (Chapman, Perry, & Strine, 2005; Lee, Chein, & Chen, 2007). Individual physical inactivity not only affects the individual, but the larger public as well. This also in turn influences the economic burden of these diseases.

About 90% of Americans use motorized transportation, leaving less than ten percent who use active transportation (Gordon-Larsen, Nelson, & Beam, 2005). Active transportation (AT) is commuting under one's own power. Examples include walking or bicycling. This is evident by the portion of the public that lives away from work, school, and recreation. Many children are bussed to school; Many parents commute by car to work, and to dine out. Apparently few are traveling under their own power to arrive at these places. The rate of AT is thought to be higher among students and those with out access to personal motorized transportation (Molina-Garcia, Castillo, & Sallis, 2010). Research indicates that America falls behind rates of AT use in foreign countries (Bere, Seiler, Eikemo, Oenema, & Brug, 2011; Bringolf-Isler et al., 2008; Larsen et al., 2009). However consistent and reliable estimates are generally unknown for the national adult population. Those who used AT were also seen to be more physically active outside of their commute compared to non-AT users (Pucher, Buehler, Bassett, & Dannenberg, 2010). This could be an option to consider for physical activity promotion.

Similar to PA, AT possesses its own set of barriers. Among barriers to AT, chronic
health conditions like overweight, obesity and diabetes can pose major impediments to persons using AT, similar to a barrier posed for engaging in PA (Gordon-Larsen, Nelson, & Beam, 2005; Pucher, Buehler, Bassett, & Dannenberg, 2010; Rosenberg, Sallis, Conway, Cain, & McKenzie, 2006). Another common barrier to AT is the concern about safety and/or issues related to the built environment. This could include busy roadways, major road crossings, lack of sidewalk connectivity, personal safety en-route, and availability of bike lanes (Bejleri, Steiner, Fischman, & Schmucker, 2011; Timperio et al., 2006; Titze, Stronegger, Janschitz, & Oja, 2008).

**Statement of the Problem**

Physical inactivity has been demonstrated to be an existing issue among Americans. This concern is amplified when considering the growing rate of overweight and obesity, cardiovascular disease, and sedentary-lifestyle related diseases. About 20% of Americans are getting the recommended allotment of exercise per week, with another quarter getting no exercise in a given week (Keim, Blanton, & Kretsch, 2004). Active transportation could be a valuable alternative to promoting PA. Currently, AT use appears to be more popular among non-American countries.

Previous AT studies have largely been conducted outside of America. Between them, the survey appears to be in instrument of choice, but some used pedometers and other instruments to measure PA. A few have used geographic information systems (GIS) to map and measured commuting distances. Non-American locations of research include Canada, Switzerland, the Netherlands, and Australia. There have been a few broader studies conducted in America: one using the Behavioral Risk Factor Surveillance System (BRFSS) data from the Centers for Disease Control and Prevention (CDC), and the other using data
from the National Longitudinal Study of Adolescent Health (Gordon-Larsen, Nelson, & Beam, 2005; Pucher, Buehler, Bassett, & Dannenberg, 2010). There appeared one study of college students, at the Arizona State University campus. This study’s focus was to describe differences between motorists and AT users with respect to their physical activity. There were no studies that reported using theory to describe or predict AT use. The purpose of this study will be to predict active transportation behavior among University of Cincinnati (UC) students using the Theory of Planned Behavior.

**Significance of the Study**

The growing problem of physical inactivity in America will be addressed by this study. Physical inactivity produces both individual and societal consequences. This study will add to the literature by exploring a relatively unstudied topic: active transportation. Plus, this study will use the Theory of Planned Behavior, something which no other study to date has done in describing and predicting this health behavior. The Theory of Planned Behavior (TPB) will be used because it is designed with the intention to predict behavior. Plus the constructs it is composed of are of interest and value to understanding AT behavior. Findings from this research could potentially be very valuable to health educators and practitioners. Intervention programs could be based on the findings of this study in order to promote PA and health by using AT. Also, safety issues of AT could be addressed by looking at the important predictors of AT use.

**Research Questions**

1. What was the prevalence of AT use by UC students?
2. Were there differences in students’ AT beliefs between AT users and non-AT users?
3. Were there differences in students’ outcome evaluations between AT users and non-
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4. Were there differences in students’ normative beliefs toward AT between AT users and non-AT users?
5. Were there differences in students’ motivation to comply with AT use between AT users and non-AT users?
6. Were there differences in students’ control beliefs about AT between AT users and non-AT users?
7. Were there differences in students’ perceived power about AT between AT users and non-AT users?
8. Were there differences in students’ attitude toward AT between AT users and non-AT users?
9. Were there differences in students’ subjective norms about AT between AT users and non-AT users?
10. Were there differences in students’ perceived behavioral control with respect to AT between AT users and non-AT users?
11. Were there differences in students’ behavioral intention with respect to AT between AT users and non-AT users?
12. To what extent did the Theory of Planned Behavior constructs significantly predict AT in college students?

Hypotheses

Hypothesis 1. The prevalence of AT among UC students will be greater than national estimate: 14.1% (Gordon-Larsen, Nelson, & Beam, 2005).

Alternative Hypothesis 1. The prevalence of AT among UC students will be lower than
national estimates for college-aged Americans (14.1%).

Null Hypothesis 1. There will be no difference between the prevalence of AT use by UC students and national estimates (14.1%).

Hypothesis 2. The AT beliefs among students that AT-users will be higher than the attitude toward AT of students who do not use AT.

Alternative Hypothesis 2. The AT beliefs among students that use AT will be lower than the attitude toward AT of students who do not use AT.

Null Hypothesis 2. There will be no difference in the AT beliefs between students that use AT compared with students who do not use AT.

Hypothesis 3. The outcome evaluations toward AT among students that use AT will be higher than the attitude toward AT of students who do not use AT.

Alternative Hypothesis 3. The outcome evaluations toward AT among students that use AT will be lower than the attitude toward AT of students who do not use AT.

Null Hypothesis 3. There will be no difference in the outcome evaluations toward AT of students that use AT compared with students who do not use AT.

Hypothesis 4. The normative beliefs of AT among students that use AT will be higher than the normative beliefs of AT among students who do not use AT.

Alternative Hypothesis 4. The normative beliefs of AT among students that use AT will be lower than the normative beliefs of AT among students who do not use AT.

Null Hypothesis 4. There will be no difference in the normative beliefs of AT of students that use AT compared with students who do not use AT.

Hypothesis 5. The motivation to comply with AT use among students that use AT will be higher than the attitude toward AT of students who do not use AT.
Alternative Hypothesis 5. The motivation to comply with AT use among students that use AT will be lower than the attitude toward AT of students who do not use AT.

Null Hypothesis 5. There will be no difference in the motivation to comply with AT use between students that use AT compared with students who do not use AT.

Hypothesis 6. The control beliefs among students that use AT will be higher than the attitude toward AT of students who do not use AT.

Alternative Hypothesis 6. The control beliefs among students that use AT will be lower than the attitude toward AT of students who do not use AT.

Null Hypothesis 6. There will be no difference in control beliefs between students that use AT compared with students who do not use AT.

Hypothesis 7. The perceived power to use AT among students that use AT will be higher than the subjective norm of AT of students who do not use AT.

Alternative Hypothesis 7. The perceived power to use AT among students that use AT will be lower than the subjective norm of AT of students who do not use AT.

Null Hypothesis 7. There will be no difference in the perceived power to use AT between students that use AT compared with students who do not use AT.

Hypothesis 8. The attitude toward AT among students that use AT will be higher than the attitude toward AT of students who do not use AT.

Alternative Hypothesis 8. The attitude toward AT among students that use AT will be lower than the attitude toward AT of students who do not use AT.

Null Hypothesis 8. There will be no difference in the attitude toward AT of students that use AT compared with students who do not use AT.

Hypothesis 9. The subjective norm among AT of students that use AT will be higher than
The subjective norm of AT of students who do not use AT.

Alternative Hypothesis 9. The subjective norm among AT of students that use AT will be lower than the subjective norm of AT of students who do not use AT.

Null Hypothesis 9. There will be no difference in the subjective norm of AT of students that use AT compared with students who do not use AT.

Hypothesis 10. The perceived behavioral control of AT among students that use AT will be higher than the perceived behavioral control of AT among students who do not use AT.

Alternative Hypothesis 10. The perceived behavioral control of AT among students that use AT will be lower than the perceived behavioral control of AT among students who do not use AT.

Null Hypothesis 10. There will be no difference in the perceived behavioral control of AT of students that use AT compared with students who do not use AT.

Hypothesis 11. The intention to use AT among students that use AT will be higher than the perceived behavioral control of AT among students who do not use AT.

Alternative Hypothesis 11. The intention to use AT among students that use AT will be lower than the perceived behavioral control of AT among students who do not use AT.

Null Hypothesis 11. There will be no difference in the intention to use AT between students that use AT compared with students who do not use AT.

Hypothesis 12. Theory of Planned Behavior constructs significantly predicted active transportation behavior among college students.

Null Hypothesis 12. Theory of Planned Behavior constructs did not significantly predicted active transportation behavior among college students.
Theory

Although research has been conducted in the area of PA promotion, few have used theory to describe or predict behavior. Using theory while conducting research has many benefits. Theory helps distinguish measurable outcomes and can be used to specify behavior prediction (Sharma & Romas, 2010). In the 1980’s, the Theory of Planned Behavior (TPB) was developed by adding constructs to the Theory of Reasoned Action (Ajzen, 1991). The constructs of TPB that will be used in this study are as follows: behavior, behavioral intention, behavioral attitude, subjective norms, normative beliefs, and perceived behavioral control. The Theory of Planned Behavior (TPB) will be used because it is designed with the intention to predict behavior. Plus the constructs it is composed of are of interest and value to understanding AT behavior. Examples of application of TPB include predicting dietary habits, vaccination behavior, and exercise behavior (Sharma & Romas, 2010). This theory has been used in college students to predict physical activity, sexual behavior, tobacco and alcohol use, gambling, and diet (C. Blanchard et al., 2008; Cha, Kim, & Patrick, 2008; Glassman & Braun, 2010; Martin, Nelson, & LaPlante, 2010; E. J. Nehl et al., 2009; Wyker & Davison, 2010). There appears to be room for improvement in using and applying theory to health education and health promotion research, which is one reason why this study will use be using theory to predict active transportation.

Delimitations

This study was delimited by the following:

1. This study will only measure college student at the University of Cincinnati during the spring 2012 quarter.
2. Information will only be collected through a survey.

Limitations

This study was limited by the following:

1. Information was collected from a self-report survey.
2. The reading and understanding of the questions by participants.
3. The accuracy which participants responded to survey questions.

Assumptions

1. It was assumed that participants were able to read and understand the survey questions.
2. It was assumed that participants accurately remembered their behavior related to the survey questions.
3. It was assumed that participants answered survey questions honestly.
4. It was assumed that students included in the survey sample are representative of all UC students.

Operational Definitions

1. *Active Transportation (AT)* – Using non-motorized means of transportation.
2. *Exercise* – Planned and structured physical activity.
3. *Physical Activity (PA)* – Actions engaged in which involve physically moving, and are aimed at improving personal health.
4. *AT User* – For this study, an AT user is one who uses AT once per week or more.

The following are constructs of the Theory of Planned Behavior and their relationship is depicted in Figure 1:

i. *Attitude Toward Behavior* – A construct of TPB measuring the participant's
views toward AT, including benefits and barriers.

ii. Behavioral Belief – A construct of TPB measuring the participant's belief that engaging in a particular behavior will lead to specific outcomes.

iii. Control Beliefs – A construct of TPB measuring the participant's beliefs about internal and external barriers and enabling factors to performing the behavior.

iv. Motivation to Comply – A construct of TPB measuring the participant's willingness to behave according to the wishes of those personally close to them.

v. Normative Beliefs – A construct of TPB measuring what participants think or view about their subjective norms.

vi. Outcome Evaluation – A construct of TPB measuring the value participant's place on each outcome associated with performing the behavior.

vii. Perceived Power – A construct of TPB measuring participants perception of the easiness or difficulty of performing the behavior according to the conditions in control beliefs.

viii. Perceived Behavioral Control – A construct of TPB measuring how much the participant feels they have the control to engage in active transportation or not.

ix. Subjective Norm – A TPB construct measuring how a participant feels those persons close to them would like them to behave. In this study, subjective norm will measure how the participant feels what those close to them think about engaging in AT.
Figure 1. Constructs of the Theory of Planned Behavior. Adapted from “Theoretical foundations of health education and health promotion,” M. Sharma and J. A. Romas, 2010, Jones and Barlett Publishers, LLC., p. 119.
Chapter Two: Review of Literature

Physical activity (PA) is an important part of obtaining and maintaining a healthy life. As modern conveniences and societal changes continue to limit physical work, diminish, physical activity and influence behavior, exercise time decreases. This is a common problem faces by many people across the globe (Teague, Mackenzie, & Rosenthal, 2009). This chapter lays out a presentation of literature related to physical activity and active transportation. Epidemiology and barriers to PA will first be described, followed by epidemiology and barriers of AT. Findings related to the benefits of AT will then be pointed out, along with health consequences of too little PA. Studies using TPB will be discussed toward the end of the chapter. Findings will then be presented in a summarized form at the end of the chapter.

Epidemiology of Physical Activity

Prevalence of physical activity. Keim, Blanton, and Kretsch published a dismal picture of American physical activity levels (2004). From this study, only about one quarter of Americans are getting the minimum recommended amount of exercise: 150 minutes per week of exercise. About 60% of adults exercised at an irregular consistency. Another group comprising about 25% of adults obtain no physical activity. These findings do not appear to be singular to America. One Australian study collected data from over 16,000 respondents. The study reported that only 25% percent of Australian adults are getting at least 150 minutes of exercise per week (Atlantis, Barnes, & Ball, 2008). The findings of Reichert, Barros, Domingues, and Hallal further support this issue of physical inactivity. Their study focused on Brazilian residents. They reported that 26.8% of residents obtained less than 150 minutes of exercise per week (2007). It appears that low
levels of physical activity are common in America as well as other developed countries.

These national trends appear to be reflected among college students as well. A meta-analysis of physical activity in America reported that college students are vulnerable to the health implications just like everyone else (Keating, Guan, Piñero, & Bridges, 2005). Here it was reported that 40-50% of college students are physically inactive. Another study indicated that those who are active tend to exercise on average 3.5 times per week (McArthur & Raedeke, 2009). This finding that a large portion of college students are physically inactive was mirrored by an Australian study as well. This Australian study included over 2,700 participants. It was described that 47% of women were insufficiently active, and 32% of men were reported to be in the same state (Leslie et al., 1999). Interestingly, one study indicated that knowledge was a significant barrier to PA in that only forty percent of students knew what the exercise recommendations were (McArthur & Raedeke, 2009). At any rate, just like the national prevalence of physical activity, it appears like increasing college student physical inactivity is a problem not singular to America.

**Determinants of physical activity.** Atlantis, Barnes, and Ball reported that gender is an important predictor for physical activity (2008). Males appeared to be more physically active than females among the more than sixteen thousand Australian adults that were studied. This finding was supported by other research as well. A study of over twenty seven hundred Australian college students also indicated that being male was a significant predictor of physical activity (Leslie et al., 1999). Further, an English study of 187 college students indicated also that males were more likely to engage in PA compared to females (Sale, Guppy, & El-Sayed, 2000).

Social support also appeared to be an important determinant of physical activity. A
study of college student in Australia indicated that those with a socially supportive network for physical activity are more likely to engage in it (Leslie et al., 1999). A study of English college student reported that women were more likely to use social support for coping compared to men (Sale, Guppy, & El-Sayed, 2000). Men being less dependent on social networks could be one explanation for the difference between men and women’s exercise rates.

Another key determinant of PA is the value one places on it. McAurthur and Raedeke reported that the value one places on health and fitness is an important determinant of actually engaging in that behavior. Not only was the value of health and fitness an important determinant, but the perceived physical appearance benefits tended to be influential in engaging in exercise (2009).

**Barriers to Physical Activity**

There appeared to be a concern for physical inactivity among adults and others, not only in America, but around the world. This concern is not met without barriers impeding the path to increased physical activity. One study of over sixteen thousand Australian adults indicated that being overweight, obese, or having a high BMI were barriers to PA (Atlantis, Barnes, & Ball, 2008). Overweight and obesity is a relatively simple issue of an energy imbalance, but the determinants and enacting change is hugely complex. Factors such as motivation, social support and self-discipline are related. Interestingly these are also barriers to PA as well.

Related to overweight and obesity are behaviors that encourage sedentary lifestyle and less physical activity. A study of over twenty-six hundred Australian adults cited a relationship between those who engage in high levels of leisure-time Internet and
computer use and being overweight. Those who engaged in high levels of leisure-time
Interned or computer use were 1.46 times more likely to be overweight, and 2.52 times to
be obese (Vandelanotte, Sugiyama, Gardiner, & Owen, 2009).

A study of American college students reported that motivation was a key barrier to
working out (McArthur & Raedeke, 2009). Feeling motivated was common among other
groups as well. One study of black and white 9-10 year old girls also reported lack of
motivation as a significant and commonly reported barrier among participants (Kimm et
al., 2006). A further study of Mexican American women reported mirroring results, that
motivation is an important factor in physical activity. Women who were physically active
appeared significantly different than physically inactive women with respect motivation
(Guinn & Vincent, 2008).

This motivation may be internal or externally stimulated. A study of Australian
college students reported that social support can be a inhibiting barrier to PA. Lacking
social support appeared to have greater affect on women than men (Leslie et al., 1999).
Another study that further indicated the importance of lack of social support as a barrier to
PA was conducted in 2007 (Reichert, Barros, Domingues, & Hallal). Therein, along with
other barriers to PA, lack of social support was cited. On the contrary, one study of Mexican
American women indicated that social support was not a significant barrier to PA (Guinn &
Vincent, 2008). A further study by Cutts, Darby, Boone, and Brewis report the influence of
society in a larger view that a group of friends, and the influential impact that can have on
individual PA (Cutts, Darby, Boone, & Brewis, 2009).

Motivation may be related to personal energy level. One study indicated that lack of
energy posed as a significant barrier to PA (Reichert, Barros, Domingues, & Hallal, 2007).
Lack of energy level was most commonly reported as feeling tired. Physical activity requires energy, so feeling like that energy is lacking can pose as a serious impediment to PA. However, another study reported that lack of energy was not an important barrier to PA (Guinn & Vincent, 2008).

Self-discipline was reported by one study as a barrier to PA (Adachi-Mejia et al., 2010). It was hypothesized that this was influenced by the barriers lack of time and lack of interest in PA. Lack of time and interest were two common barriers reported in the literature. Studies with participants from a diverse background cited lack of time as a significant barrier to obtaining the proper amount of exercise. As young as 9-10 year olds reported that lack of time and interested were serious barriers to PA (Kimm et al., 2006). Another study of Canadian high school students again echoed that lack of time and interest are barriers to engaging in PA. A 2010 study of American mothers reported time constraints and lack of interest in PA as inhibiting personal exercise (Adachi-Mejia et al., 2010). In a study of Mexican American women, lack of time was again indicated as a significant barrier to PA (Guinn & Vincent, 2008). Lack of time and interest were further indicated as a barrier by a study of corporate health workers in 2008 (Schwetschenau, O'Brien, Cunningham, & Jex). This perception of lack of time and lack of interest being an inhibitor for physical activity is not singular to North America either. A study of Brazilian resident indicated among other barriers, that lack of time and interest were significant predictors of physical inactivity (Reichert, Barros, Domingues, & Hallal, 2007).

Further internal barriers to PA were reported as well. A study of American college students reported that mental health status was related to level of physical activity (McArthur & Raedeke, 2009). Another study indicated that feeling embarrassed was
another internal barrier to PA. Participants indicated that working out around other people, and other people they knew could be embarrassing to them (Schwetschenau, O'Brien, Cunningham, & Jex, 2008).

Aside from internal barriers, external barriers to physical activity were reported. One study of corporate employees cited lack of work-out facilities as a barrier to PA (Schwetschenau, O'Brien, Cunningham, & Jex, 2008). Employees felt that not having work-out facilities available to them was inhibiting them from engaging in exercise. Some resources have a monetary cost attached to them too, which was reported to act as a barrier for some people engaging in exercise (Reichert, Barros, Domingues, & Hallal, 2007). Having inadequate resources was further indicated in the built environment as well. A study in Phoenix, Arizona used Geographic Information Systems (GIS) to map walkable sidewalks and distance to resources. It was reported in this study that although access to resources is a serious concern, it be less concerning compared to other barriers to physical activity. Further discussion indicated that those who are typically considered as high risk generally live close to parks and other resources, but an important barrier in these neighborhoods is personal safety. It appeared that personal safety acted as a larger barrier to PA than available resources (Cutts, Darby, Boone, & Brewis, 2009). An additional study of Mexican American women reported that access to resources was not a significant barrier to engaging in physical activity, or that other barriers were larger and more important (Guinn & Vincent, 2008).

Directly related to external barriers are environmental conditions which act as deterrents to PA. Wen, Balluz, Shire, Mokdad, and Kohl III collected data from the from the United States Environmental Protection Agency (EPA) Air Quality Systems (AQS) database,
and from the Behavioral Risk Factor Surveillance Survey (BRFSS). The report noted that a sedentary lifestyle and poor environmental quality are both hazardous to health. It was further reported that these two conditions appear to be related. This relationship appeared significant before and after controlling for other covariates (Wen, Balluz, Shire, Mokdad, & Kohl III, 2009).

Less commonly reported barriers were also reported. Unemployment was reported to be associated with physical inactivity among Australian college students (Leslie et al., 1999). Age was also reported by this same study. Older students tended to be less physically active compared to younger students. Other barriers that were measured, but found to be insignificant were skills needed to perform the workout and fear of injury (Guinn & Vincent, 2008).

**Epidemiology of Active Transportation**

**Prevalence of active transportation.** Prevalence of active transportation in non-American countries were reported consistently higher than those reported for America. One study of Swiss students cited that 78% of youth travel to school using active transportation (Bringolf-Iser et al., 2008). Further work in Canada noted that 62% of students in London, Ontario, Canada report to use AT to travel to school, and 72% used AT to travel home (Larsen et al., 2009). Another study conducted in the Netherlands on reported that 33% of youth there use AT. Data here were collected from a national database representing over 2,558 youth (Bere, Seiler, Eikemo, Oenema, & Brug, 2011). An Australian study, which only looked at bicycling reported a rate of 22.5% of Australian adults using biking for AT (Titze, Stronegger, Janschitz, & Oja, 2008). Another Australian study looking at youth who used AT greater than one time per week, reported that 41%
achieved this (J. Salmon, Salmon, Crawford, Hume, & Timperio, 2007).

The scenario in America appears somewhat different. Gordon-Larsen, Nelson, and Beam looked at American adults and their transportation behavior (2005). They reported that 90.4% of Americans drive to work, with the remaining 9.6% using mostly public transportation, and some using active transportation. This same study did report though that the rate of motorized transportation to school tended to be lower than the percent who drove to work. Of commuters to school, 74.7% were reported to use motorized transportation. Another study further supports the relatively low rate of AT use in America. Bungum, Lounsbery, and Moonie looked at AT among American youth, and reported that 15% of adolescents used AT to commute to school (Bungum, Lounsbery, & Moonie, 2009). One explanation for these rates could be that many people do not live close to their destination. A different study of American adolescents traveling to school indicated that only 10% lived within a half mile of school. The reported median distance to school was 1.68 miles (Babey, Hastert, Huang, & Brown, 2009). It would be expected that the percent living within a half mile would increase for work. This study did report however, that half the students used AT at least once per week, and 25% used AT at least three times per week.

**Determinants of active transportation.** A key determinant of active transportation that was cited by a study which sampled over ten thousand youth was being physically active outside of commuting (Gordon-Larsen, Nelson, & Beam, 2005). Another AT study using a large sample from the BRFSS database was conducted in 2010 (Pucher, Buehler, Bassett, & Dannenberg). This study further supported the finding that having a physically active lifestyle is a key determinant of AT use. Those who used AT tended to be
more physically active outside of commuting compared to non-AT users.

The finding that physical activity is related to AT use appears to be related to weight status. The same study by Gordon-Larsen, Nelson, and Beam indicated that youth who used AT tended not to be overweight compared to non-AT users (Gordon-Larsen, Nelson, & Beam, 2005). Rosenberg, Sallis, Conway, Cain, and McKenzie reported similar findings. Their study also was conducted among American youth, and indicated that body size had some influence on AT use. It was reported that not being overweight was more strongly linked with using AT (Rosenberg, Sallis, Conway, Cain, & McKenzie, 2006).

Similar to physical activity, AT behavior appeared to be related to gender. Men were found more likely to engage in physical activity (Atlantis, Barnes, & Ball, 2008). Men were also more likely to engage in AT use compared to females, as was reported by Larsen, et al. in a study among Canadian youth (2009). This finding did not appear singular to Canadian youth either. A study by Babey, Hastert, Huang, and Brown of American youth further indicated that being male was strongly related to engaging in active transportation (2009). This same study also reported that students that were latino, low-income, and attending public schools were more likely to engage in AT. The relationship between being low-income and using AT was further supported in a study of Canadian youth (Larsen et al., 2009). Along with attending public schools, being a full-time student was described as being related to AT use in a study of American young adults (Gordon-Larsen, Nelson, & Beam, 2005). There appears to be some ethnic, income, student status and geographic determinants to AT use.

There existed a variety of literature regarding geographic location and AT use. Primary among them was distance to destination. Larsen, et al. in their study of active
transportation further noted that distance to destination was a significant determinant of AT use (Larsen et al., 2009). This finding was mirrored by Babey, Hastert, Huang, and Brown among American youth; living close to the destination was equated to a higher likelihood of engaging in AT (2009). Further study by Sisson and Tudor-Locke report that short distance is a key determinant of AT among American college students (2008). In a study of Australian youth, Timperio, et al. reported that living less than half a mile away from school was significantly related to engaging in AT (2006). Further geographic determinants to using AT were reported by Larsen, et al. (2009). Chief among them were living in urban areas, living in an area of low residential density, and the route to destination being scenic.

Another group of related determinants include facilities in the built environment. Access to bicycling facilities were reported to be a significant determinant of AT use by Molina-Garcia, Castillo, and Sallis (2010). Study participants were Spanish college students. A study among a different population, Australian adults, added to the growing body of literature that access to AT resources is a predictor of AT use. In particular connectivity and availability of bike lanes are a key determinant in bicycle use (Titze, Stronegger, Janschitz, & Oja, 2008).

Further, individual decision making appeared to be importantly related to AT use. In a study among Swiss students, personal and lifestyle decisions were related to engaging in AT (Bringolf-Isler et al., 2008). The importance of decision making is related to personal confidence in engaging in and completing the behavior: self-efficacy. Molina-Garcia, Castillo, and Sallis reported that self-efficacy as a significant determinant of AT behavior (2010).
Barriers to Active Transportation

Similar to barriers to PA being overweight or obese was reportedly a barrier to AT use. In a study of Dutch adolescents reported that body size can act as a barrier to AT, particularly, being overweight or obese (Bere, Seiler, Eikemo, Oenema, & Brug, 2011). This was further sustained by two American based studies. Gordon-Larsen, Nelson, and Beam studied over ten thousand American young adults, and reported a significant negative relationship between being overweight and AT use (Gordon-Larsen, Nelson, & Beam, 2005). Pucher, Buehler, Bassett, and Dannenberg studied American adults and arrived at the same finding; overweight appeared to be a barrier to AT use (2010). This same study also pointed about that diabetes, another chronic disease, is negatively related to AT use. One study among Australia youth however, reported that weight status was not a significant barrier to AT use (Timperio et al., 2006). This same study also reported that energy level was not a significant barrier to at use.

Related to overweight and obesity is physical activity. A study of American college students reported that being more sedentary was negatively related to AT use, indicating that being more sedentary may pose a barrier to AT behavior (Sisson & Tudor-Locke, 2008). In addition to and related to sedentary lifestyle posing as a barrier to AT, a person perception of discomfort during PA was reported as a barrier to AT. A study of one thousand Australian adults indicated that physical discomfort was an important obstacle in the way of them using AT (Titze, Stronegger, Janschitz, & Oja, 2008).

Similar to personal barriers, external conditions can inhibit engaging in AT. Among external barriers the particular route taken can pose as a barrier for some. A study of Swiss students actively commuting indicated that major road crossings and safety en route was a
major barrier of using AT (Bringolf-Isler et al., 2008). The safety of the route was further reported from a study of Australian youth, indicating that a variety of internal, social, and external barriers work together to impede engagement in AT behavior (J. Salmon, Salmon, Crawford, Hume, & Timperio, 2007). Another Australian based study again cited that the route traveled acted as a barrier for some (Timperio et al., 2006). Routes along or crossing major roadways, and roads with no traffic lights were reportedly seen as unsafe routes. This study also pointed out that for youth ages 5-6, parental perception of the terrain of the route acted could act as a barrier for child AT use. Additional barriers reported in the built environment were sidewalk availability and connectivity, permeability of neighborhoods, and connectedness of roadways (Bejleri, Steiner, Fischman, & Schmucker, 2011). The idea here is that housing subdivisions can geographically isolate homes from travelling paths. In some instances homes are close by Euclidian distance, but considerable distance is added by traveling by street because of this neighborhood penetration issue. Distances and locations were mapped using GIS.

Whatever the reason for the distance, long traveling distances were reported as a common inhibitor of AT use. In a study of London, Ontario students Larsen, et al. reported that distance to destination was an important factor preventing AT use. Here student residents were also mapped using GIS, and was linked to their reported AT use (Larsen et al., 2009). Salmon, Salmon, Crawford, Hume, and Timperio studied the AT behavior of 720 Australian youth (2007). Their findings also report long traveling distances as a major inhibitor of using AT. This study also reported time as a barrier to AT use. Long distances can translate to longer commute time. This was again supported by Sisson and Tudor-Locke whose study of American college students compared bicyclists and motorists; long
distance again was related to decreased AT use (Sisson & Tudor-Locke, 2008). Related to long distances, Titze, Stonegger, Janschitz, and Oja asked participants about the practicality of using bicycling as transportation. They reported that many viewed bicycling as a mode of transportation as impractical (OR=0.49) (2008).

Other resources available were reported as barriers to AT use too. Bringolf-Isler, et al. reported that the number of cars available at home was related to the likelihood students would use AT (Bringolf-Isler et al., 2008). A study of Spanish college students further pointed out that access to private motorized transportation was a significant impediment to AT use (Molina-Garcia, Castillo, & Sallis, 2010).

There appeared a myriad of barriers or concerns by parents for allowing their children to use AT. In a study of Swiss students, Bringolf-Isler, et al. reported that age posed an important barrier to starting AT, and for younger students, day-care attendances was noted as a reason why AT was not used (2008). Other reported barriers for youth engaging in AT were lack of social group for the youth to travel with, that is there were not adults, or no other youth to travel with. Parent concern for youth engagement in risk taking behavior was also cited with reluctance to use AT (J. Salmon, Salmon, Crawford, Hume, & Timperio, 2007). Another parent perception that held youth back from AT use was their perception that few other youth were using AT (Timperio et al., 2006).

One study however cited that family influence was not a significant barrier to AT use (Timperio et al., 2006). Babey, Hastert, Huang, and Brown also reported lack of supporting evidence that family factors significantly impede AT use (2009). Their study among American youth reported that parental supervision, parental use of AT, and parent perception of neighborhood safety were not barriers to AT use.
Benefits of Active Transportation

It was reported that AT is not an effective instrument for weight loss. Rather it appeared to be an effective instrument for maintaining weight, and preventing weight gain. These results come from a two-year cohort study of nearly two thousand fourth and fifth grade California students (Rosenberg, Sallis, Conway, Cain, & McKenzie, 2006). Further, the issue of safety while commuting was addressed by De Hartog, Jeroen, Boogaard, and Nijland (2010). This study sought to determine if the benefits of AT use outweighed the risks by simulating the outcome if 500,000 Dutch adults changed from motorized transportation to bicycling. After considering air quality improvements, physical and mental health improvements, this study reported that the increased health benefits, including longer life, less inhaled air pollution, and less traffic accidents (i.e. the benefits of AT use) outweighed the risks. This conclusion came after accounting for the likelihood of AT fatalities and other accidents common in AT use. Despite the inherent risks of AT, this study indicated the benefits outweigh them.

Health Consequences of Physical Inactivity

Numerous health risks of physical inactivity exist. A 2010 study sought to describe the health risks related to elevated resting heart rate (RHR) (Cooney et al.). This was done by using data from the National FINRISK study, which was a representative, prospective study in Finland. Over ten thousand men and over eleven thousand woman participated in the study. Persons who were already diagnosed with cardiovascular disease (CVD) were excluded from the study. It was determined that RHR is strongly related to CVD, even after controlling for other variables. It was also described that RHR is strongly related to BMI, systolic blood pressure, smoking, and physical inactivity.
Besides just increase risk for CVD, persons are at risk for other health conditions. From another study that was conducted on Tennessee adults there appeared a further relationship between physical inactivity and health consequences (Hart, Barreira, & Kang, 2010). This study used data from the 5,024 respondents to the 2008 BRFSS in Tennessee. It appeared that 28.9% of adults engaged in no LTPA. Sociodemographic factors related to no LTPA appeared to be having less than a high school diploma, being Hispanic, and being advanced in age. No LTPA was significantly related to several health status markers as well: Self-reported health, smoking, obesity, and cardiovascular disease.

Additional research indicates that physical inactivity is related to even more disease states. A study of diabetes risk factors sought to summarize evidence via meta-analysis (Qin, Knol, & Corpelejin, 2010). A PUBMED search was conducted to find studies about diabetes risk factors. From the body of literature, it was discovered that diabetes is strongly liked to obesity and physical inactivity, and physical inactivity and obesity are strongly linked with each other. It was suggested that preventing either obesity or physical inactivity will prevent diabetes. This also suggested that if one was prevented (obesity or diabetes), the other was usually stopped too.

One 2007 study sought to describe the relationship between PA and breast cancer. The study use a case-control design with two hundred fifty Polish women from Western Pomerania, and a control group of three hundred one women from the same area. It was indicated that physical activity is an important preventative behavior against breast cancer. Women ages fourteen to twenty who exercised regularly during this time had lower risk of breast cancer compared to women who started PA after age twenty (Kruk, 2007).

Disease states are not the only affect physical inactivity can have. A meta-analysis
study was conducted to further understand the relationship between depression and chronic diseases (Chapman, Perry, & Strine, 2005). Therein it was discovered that depression is associated with a variety of chronic diseases including asthma and arthritis. It was also reported that depression is related to a variety of lifestyle conditions, including physical inactivity.

Although depression is often related to fatigue, it isn’t always. Fatigue is a common ailment that many people deal with (Lee, Chein, & Chen, 2007). This study was conducted to explore fatigue among graduate students at a Taiwan university. Data were collected via survey from 1,806 new graduate students to determine risk factors and protective factors for fatigue. Fatigue was significantly related to diet, exercise habits, sleep patterns, type of graduate program, and chronic disease. Intensity of physical activity was a protective factor against fatigue. Physical activity plays an important role in fatigue commonality.

**Theory of Planned Behavior**

The Theory of Reasoned Action was developed in the 1970’s and consists of eight constructs: behavior, behavioral intention, attitude toward the behavior, outcome evaluations, subjective norm, normative beliefs, and motivations to comply. By the 1980’s three additional constructs were added to the theory, at which time it took the name Theory of Planned Behavior: perceived behavioral control, control beliefs, and perceived power. This theory is based on the idea that individual intention is determined by a preexisting factor(s), mainly personal factors and social influences. Strengths of the Theory of Planned Behavior (TPB) is its ability to predict behavior, and it has been widely used in health education and promotion. On the other hand, TPB does not consider in detail behavior change, personality factors, or demographic variables which can shape behavior
Exercise applications. The TPB has been used widely in various settings. A few examples are described here of its use in exercise promotion. A 2009 study used TPB to determine social pressures felt persons who were overweight and normal-weight persons with regard to using a health/fitness club (W. C. Miller & Miller). Participants were collected with the help of an online research marketing firm, Luth Research, LLC. One thousand one hundred eighty three overweight persons, and 550 normal-weight persons filled out the twelve-item survey. The survey was designed to measure five of the TPB constructs: normative belief, motivation to comply, subjective norm, behavior, and behavioral intent. It appeared that overweight persons felt more pressure to used a health/fitness club for exercise than did normal-weight persons. The motivation to comply appeared the same between groups.

Another study which used TPB was conducted in 1999 (Smith & Biddle). Three smaller scale studies were analyzed and reported at the same time. The studies were conducted to determine the value of using TPB in adherence to private fitness club exercise. Participants from the three studies were volunteers, some of that belonged to a private fitness club, and some were rural residents. Constructs that were measured from TPB were attitude toward exercise, subjective norm, behavioral intention, and perceived behavioral control. It was reported that attitude toward exercise and subjective norm accounted for thirteen percent of the variation in adherence. From qualitative data collected, subjective norm was reported to be an important variable according to participants.

This study purposed to use TPB to predict moderate-to-vigorous physical activity
(MTVPA) among sixth grade youth (Trost, Saunders, & Ward, 2002). One hundred ninety eight students participated by completing a questionnaire that measured TPB constructs, and by wearing an accelerometer to measure MTVPA. Constructs that were measured were subjective norms, perceived behavioral control, intentions to be physically active, and attitude toward PA. Although TPB appeared to be a good fit for this study the results to not indicate likewise. The constructs measured only accounted for thirteen percent of variation in MTVPA. When looking at attitude toward PA and subjective norms aside, twelve percent of the variation in MTVPA was explained.

**TPB used with college students.** The TPB has been used somewhat limitedly among college students. The main areas of application with this group have been sexual behavior, alcohol use, tobacco use, gambling, safety, and PA. One study used TPB to determine intention of college students to use condoms (Cha, Kim, & Patrick, 2008). A questionnaire was used to measure all the constructs of TPB. Participants were Korean college students aged eighteen to twenty five years. They were recruited to participate via on-campus flyers and self-referral. It was reported that all the constructs of TPB were significant in predicting male use of condoms, whereas only condom attitude and condom efficacy were significant for females. Using TPB appeared a useful theory in this case and with this group of people.

Another study focused on determining nonsmoking intention between black and white college students (E. J. Nehl et al., 2009). A survey was used to collect data from 238 black and 197 white college students. It was determined that white students had a stronger nonsmoking intention, which was influenced by their subjective norms. Black students’ nonsmoking intention appeared to be influenced by their attitudes toward smoking. For
both groups, perceived control was a strong predictor of nonsmoking. The TPB appeared to prediction with out statistically moderating results based on ethnicity, indicating its good use for ethnicity-specific interventions, and may be good for other non-tobacco related studies.

A 2010 study used TPB to describe dietary change (Wyker & Davison). Here, a cross-sectional study of predicting college student adoption of a plant-based diet at a large public university in the northeastern United States was conducted with two hundred four college students. Participants’ data were collected via survey that measured the constructs of TPB. It appeared that the following TPB constructs were significant in predicting adoption of a plant-based diet, explaining sixty one percent of the variation in adoption: outcome evaluation, normative beliefs, control beliefs, normative belief, and subjective norm. It was reported that TPB is a useful tool in predicting college student behavior with regard to dietary change.

A different study assessed how well TPB predicted alcohol consumption on game-day by college students (Glassman & Braun, 2010). Three cohorts of one thousand students were selected randomly. A web-based survey assessed the constructs of TPB. It was reported that attitude toward alcohol consumption and subjective norms significantly predicted student intentions to consume alcohol on game-day. This finding was consistent among all three cohorts studied. Perceived behavioral control was not a consistent predictor of game-day alcohol use among college students. It was concluded that some constructs of TPB proved useful in predicting alcohol consumption on game-day, but not all of them were useful. The complete framework of TPB appeared limited in this scenario.

Other behaviors have been described using TPB with college students. Exercise
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A study of PA and college students using TPB sought to predict exercise behavior and determine the usefulness of TPB with different ethnic groups (C. Blanchard et al., 2008). Students participating consisted of 238 African Americans and 197 Caucasians. These students completed the initial questionnaire and the follow-up PA measure a week later. It was reported that attitude toward PA and behavioral control were significant predictors of PA among Caucasian and African American college students. It was suggested that when considering intervention to base it on theory, which allows predicted behavior among different ethnic groups.

A different topic that still used TPB with college students was reported in a study that approached bicycle helmet use among college students while riding for recreation or transportation (Kakefuda, Stallones, & Gibbs, 2009). A total of one hundred ninety two students at a Colorado university returned questionnaires about bicycle helmet behavior. The questionnaire was crafted using the health belief model and TPB. Constructed from TPB that were used were bicycle helmet use attitude and subjective norms. It appeared that only 9.4% of students used helmets while commuting, whereas 36.5% used helmets while rising for recreation. The significant variables were inconsistent between the two groups. It was suggested that these differences might be attributed to different psychosocial structures in the two groups.

A different approach to a health topic used TPB to approach college gambling (Martin, Nelson, & LaPlante, 2010). This study called gambling a threat to public health. Students enrolled in a grouping of general elective classes at a large American university were eligible for the study. Seven hundred eighty five completed the assessment battery. The purpose was to predict Gambling behavior using TPB. It appeared that subjective
norms, perceived behavioral control, gambling behavior, and gambling attitude were predictive of college student gambling. The study also reported that intention to gamble was a mediator between these variables and gambling behavior. The study concluded that college anti-gambling interventions should use constructs from TPB to bring change in college student gambling: targeting subjective norms, attitudes, etc.

**Summary**

There seems to be a relatively low prevalence of physical activity globally, including in America. Just as sedentary lifestyle is becoming more common among all groups, physical inactivity is becoming more common among college students as well nationally and internationally. Key determinants of physical activity appear to be gender, available social support, and exercise being seen as valuable.

Related to decreasing rates of PA are barriers. Chief among them was time. This was followed by motivation, interest in exercising, lack of social support and resources available for exercise. There appeared a variety of other barriers as well, but these five were the most common. Others included being overweight, age, knowledge/skills, lack of energy, concerns about safety, and feeling embarrassed.

Active transportation prevalence appeared higher in all countries studied outside of America. National estimates of AT use were generally low. Key determinants to AT use were being physically active outside of commuting, not being overweight, being male, short commuting distance, living in an urban area with low residential density, being a full-time student, and possessing high self-efficacy.

Barriers to active transportation included chronic disease and physical discomfort. Also reported were barriers in the built environment: safety of the route, connectivity of
sidewalks and roads, and distance to destination. A variety of barriers were reported for young students such as age, social group for commuting, and parental concerns associated with AT use. There were reported mixed results for parental influence on AT use however. Access to other resources such as motorized transportation seemed to act a barrier to AT use too.

Despite the risks involved in AT use, AT appears to be effected at preventing weight gain, and a number of other benefits. Other benefits appear to be air quality, and mental and physical health improvements.

Reported health conditions related to physical inactivity included increased risk for the chronic diseases cardiovascular disease, obesity and diabetes. Those who are physically inactive are also more likely to be smokers. Being physically inactive increased the risk of cancer, in particular breast cancer. Also, depression and fatigue is more common among persons who lack PA in their life.

Applications of TPB with college students have generally focused on five main areas. This theory has been used to predict sexual behaviors, smoking intentions, dietary changes, and alcohol use. This theory has also been used to describe bicycle helmet use among college students. This theory has also been used to predict gambling intention among college students. It has also been used to predict PA among college students.
Chapter three: Methods

Research indicates that Americans are becoming more sedentary people. It was reported that sixty percent of Americans exercise inconsistently, and an additional twenty-five percent not exercising at all (Keim, Blanton, & Kretsch, 2004). The problem only appears slightly better among college students. Studies report that forty to fifty percent of college students are not getting adequate exercise (Keating, Guan, Piñero, & Bridges, 2005). It is evident that Americans of all ages and groups are not getting proper amounts of exercise, increasing the risk for an array of diseases.

Most other AT studies were conducted outside the United States. The most commonly used instrument was the survey. Other common instruments included pedometers, geographic information systems (GIS), and exercise diaries. Two American based studies used large, national databases for data collection; One used the Behavioral Risk Factor Surveillance System (BRFSS) database, and the other used the National Longitudinal Study of Adolescent Health (NLSAH) (Gordon-Larsen, Nelson, & Beam, 2005; Pucher, Buehler, Bassett, & Dannenberg, 2010). Only one study was found that studied AT among college students. Its main focus was to determine differences between motorists and AT users with respect to physical activity (Sisson & Tudor-Locke, 2008).

The purpose of this study will be to predict active transportation behavior among University of Cincinnati (UC) students using the Theory of Planned Behavior. This study will address the area of growing concern related to physical inactivity, which has both individual and societal consequences. This study will add to the literature by conducting
research on a relatively unstudied topic. Additionally, the Theory of Planned Behavior will be used to predict AT use among college students. The use of theory is something that no other AT study to date has done. The Theory of Planned Behavior (TPB) will be used because it is designed with the intention to predict behavior. Plus the constructs it is composed of are of interest and value to understanding AT behavior. The results from the study could be useful in creating and implementing exercise programs. This study could also be illuminating in terms of the methodology used to approach this topic too, since it is a relatively unstudied topic. This study is potentially very valuable, helping opening the door to this area of research.

**Participants**

Participants for this study were recruited from the student body of the University of Cincinnati (UC). The University of Cincinnati is a large, urban institution with over 41,000 thousand students. The University offers over 300 degree granting programs, and serves students regionally, nationally, and internationally.

Those participating in the study must have been enrolled at UC during the spring quarter, 2011. The survey will be emailed to all students via the University Registrar’s office. A power analysis will be conducted to determine a minimum sample size to selected.

**Instrumentation**

The instrument for this study will be created using constructs of TPB. Questions will also be asked about demographics, proximity to school and/or work. In order to establish validity the instrument will be sent to four experts. Their feedback and evaluation will be incorporated in refining the instrument. Reliability will be determined
by test-retest among at least thirty students. This group of students will be administered
the survey, then two weeks later the same group will be re-administered the same survey.
Students will be selected from a UC Health Promotion and Education class. A correlation
coefficient (Chronbach’s α) will be calculated to determine the reliability of the instrument.

The instrument will have 45 questions: 10 items measuring demographic,
geographic, and current behavior information, as well as 35 items measuring the proximal
constructs of TPB with seven questions each will be used. The behavioral beliefs will be
measured using a Likert scale: -3=Extremely Unlikely; -2=Quite Unlikely; -1=Slightly
Unlikely; 0=Neutral; +1=Slightly Likely; +2=Quite Likely; +3=Extremely Likely. Outcome
evaluations will be measured using the following Likert scale: -3=Extremely Bad; -2=Quite
Bad; -1=Slightly Bad; 0=Neutral; +1=Slightly Good; +2=Quite Good; +3=Extremely Good.
From these two constructs the participants attitude toward the behavior will be derived
using the following formula

\[ BA = \sum Bb \cdot Oe \]

where BA=Attitude Toward Behavior, Bb=Behavioral Beliefs, and Oe=Outcome Evaluations.
Normative beliefs, which is how a person feels others close to them would like them to
behave, is measured using the following Likert scale: -3=Strongly Disagree; -2=Moderately
Disagree; -1=Slightly Disagree; 0=Neutral; +1=Slightly Agree; +2=Moderately Agree;
+3=Strongly Agree. The fourth construct, motivation to comply, will be measured using a
seven-point Likert scale ranging from Extremely Unlikely to Extremely Likely. The
constructs normative beliefs and motivation to comply are used to calculate subjective
norm using the following formula
\[ SN = \sum Nb \cdot Mc \]

where \( SN \)=Subjective Norms, \( Nb \)=Normative Beliefs, and \( Mc \)=Motivation to comply.

Measuring control beliefs will be done using a seven-point scale ranging from Extremely Unlikely to Extremely likely. Perceived power will be measured using the following Likert scale: -3=Extremely Difficult; -2=Moderately Difficult; -1=Slightly Difficult; 0=Neutral; +1=Slightly Easy; +2=Moderately Easy; +3=Extremely Easy. The constructs, control beliefs and perceived power will be used to calculate perceived behavioral control. This will be done using the following formula

\[ PBC = \sum Cb \cdot Pp \]

where \( PBC \)=Perceived Behavioral Control, \( Cb \)=Control Beliefs, and \( Pp \)=Perceived Power.

The three derived constructs, attitude toward behavior, subjective norms, and perceived behavioral control will be used to derive behavioral intention.

\[ BI = BA + SN + PBC \]

where \( BI \)=Behavioral Intention. The behavioral intention will be used to predict actual behavior.

**Procedures**

Following a formal project proposal and approval by this thesis committee, submission to the Institutional Review Board (IRB) at the University of Cincinnati will be made. A formal letter of support will also be requested from the UC Registrar’s office. Also, a cover letter will be drafted to be included in the email sent to participants. The survey and cover letter will then be emailed to students. Students will have one week to access the survey, after which time the survey will be closed and the collected information will be
analyzed. An *a priori* sample size with $\beta=0.80$ was determined to be 200 (Lenth, 2012). It is anticipated that the number of responses will be well in excess of this number.

**Data Analysis**

After compiling the survey information, data will be analyzed using R statistical software version 2.14.2 (R Development Core Team, 2012). This analysis includes descriptive statistics on all constructs and variables measured. Differences between means among AT users and non-AT users within constructs of TPB will be assessed using *t*-tests. Prediction of behavior will be assessed using linear regression analysis. A chi-squared test will be used to determine a difference exists in the proportion of UC students who report using AT compared to national estimate (14.1%).

**Summary**

The purpose of this study will be to predict active transportation behavior among University of Cincinnati (UC) students using the Theory of Planned Behavior. The use of theory to predict AT behavior will be useful in understanding and promoting AT use. This study will use a questionnaire to gather data from UC students via an email from UC’s Office of the Registrar. Data will be collected and analyzed using linear regression analysis as well as descriptive and chi-squared statistics.
Chapter 4: Results

The purpose of this study was to use Theory of Planned Behavior to predict active transportation (AT) among college students. Data was collected from 1,280 respondents via online survey. Demographic information about this sample is as follows: 62% were female; the median age was 21; an equal representation of academic classes was represented (e.g. freshman, sophomore, etc.); 85% were White; 62% live within 3 miles of campus. The sample demographics from this study are comparable to the overall student body at the University of Cincinnati, but there was a higher percentage of female and White participants: 55% female, median age of 21, and 73% White (University of Cincinnati Office of Institutional Research, 2011).

The survey data indicated that UC students used AT an average of 4.4 days per week. Weekly AT use ranged from zero days per week to seven days per week. Roughly 25% reportedly use AT one or fewer days per week; 25% also reported using AT seven days per week; 25% reported using AT 1-5 days per week; And 25% reported using AT 5 to 7 days per week. A histogram of this data appeared bimodal with a peak at seven days per week and a peak at zero days per week. For this reason AT users were classified for this analysis as having used AT any times during the week; and non-AT users used AT zero times per week. This aligns with previous research in characterizing AT use by (Gordon-Larsen, Nelson, & Beam) in which college aged participants were categorized as using At or not using AT (2005). This study showed that roughly 14.1% of college-aged persons use AT. Chi-squared analysis indicated that UC students use AT significantly more ($\chi^2=4369.17$,}
df=1, \( p<0.001 \)). For this reason, Null Hypothesis 1 is rejected, that there is no difference between national estimates and UC student use of AT. We therefore conclude that there is a significant difference between UC students AT use and National estimates.

Significant differences were observed with respect to weekly AT use and distance to campus. The overall percent of students using AT weekly was 78.4\%. However, as students lived further from the school, the less likely they were to use AT at least weekly: lived less than one mile (94.5\%), lived 1-3 miles (86.5\%), lived 3-5 miles (63.5\%), and lived greater than 5 miles from school (53.5\%). Chi-squared analysis showed significant differences between less than one mile and 1-3 miles (\( \chi^2=12.91, p<0.0001 \)) and 1-3 miles and 3-5 miles (\( \chi^2=15.18, p<0.0001 \)). But there was not a significant difference between 3-5 miles and greater than 5 miles (\( \chi^2=1.81, p=0.18 \)). This analysis showed a gradient in use of AT, where those closer to the university were more likely to use AT. But, when students were further than 3 miles away, the differences in AT use were no longer significant.

There were significant differences with respect to all TPB constructs. As displayed in Table 1, all constructs except those dealing with behavior control (control beliefs, perceived power and perceived behavioral control) had statistically higher outcomes for AT users; Non-AT users had statistically higher outcomes for the behavior control constructs of TPB.

Table 1

<table>
<thead>
<tr>
<th>TPB Construct</th>
<th>( t ) (df)</th>
<th>( p )</th>
<th>User type with higher score</th>
</tr>
</thead>
</table>

*Mean Differences between AT and Non-AT users for TPB Constructs*
Results 43

<table>
<thead>
<tr>
<th>TPB Construct</th>
<th>t (df)</th>
<th>p</th>
<th>User type with higher score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral beliefs</td>
<td>2.009 (396.2)</td>
<td>0.045</td>
<td>AT users</td>
</tr>
<tr>
<td>Outcome evaluations</td>
<td>5.944 (421.5)</td>
<td>&lt;0.001</td>
<td>AT users</td>
</tr>
<tr>
<td>Attitude towards behavior</td>
<td>6.008 (437.1)</td>
<td>&lt;0.001</td>
<td>AT users</td>
</tr>
<tr>
<td>Normative beliefs</td>
<td>11.718 (342.7)</td>
<td>&lt;0.001</td>
<td>AT users</td>
</tr>
<tr>
<td>Motivation to comply</td>
<td>10.870 (361.4)</td>
<td>&lt;0.001</td>
<td>AT users</td>
</tr>
<tr>
<td>Subjective norms</td>
<td>10.508 (463.7)</td>
<td>&lt;0.001</td>
<td>AT users</td>
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<tr>
<td>Control beliefs</td>
<td>-7.643 (397.1)</td>
<td>&lt;0.001</td>
<td>non-AT users</td>
</tr>
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<td>Perceived power</td>
<td>-3.580 (440.1)</td>
<td>0.0003</td>
<td>non-AT users</td>
</tr>
<tr>
<td>Perceived behavioral control</td>
<td>-5.133 (352.5)</td>
<td>&lt;0.001</td>
<td>non-AT users</td>
</tr>
<tr>
<td>Behavioral intention</td>
<td>5.333 (346.6)</td>
<td>&lt;0.001</td>
<td>AT users</td>
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</table>

With respect to AT beliefs, students who were AT-users had significantly higher beliefs compared with non-AT users. For this reason we reject null Hypothesis 2, that the AT beliefs among students that use AT regularly will be the same as the attitude toward AT of students who do not use AT regularly.

There appeared a significant difference between AT users and non-AT users with respect to outcome evaluations. The analysis indicated that AT users had higher outcome evaluation scores compared to non-AT users. For this reason null Hypothesis 3 was rejected, that there was no difference in outcome evaluations between AT users and non-AT users.

There appeared a significant difference between AT users and non-AT users with
respect to attitude toward AT use. The analysis indicated that AT users had higher attitude toward AT use scores compared to non-AT users. For this reason we reject null Hypothesis 4, that there was no difference in attitude toward AT use between AT users and non-AT users.

There was a significant difference between AT users and non-AT users with respect to normative beliefs. The analysis indicated that AT users had higher normative belief scores compared to non-AT users. For this reason we reject null Hypothesis 5, that there was no difference in normative beliefs between AT users and non-AT users.

This analysis showed a significant difference between AT users and non-AT users with respect to motivation to comply. The analysis indicated that AT users had higher motivation to comply scores compared to non-AT users. For this reason we reject null Hypothesis 6, that there was no difference in motivation to comply between AT users and non-AT users.

There was a significant difference between AT users and non-AT users with respect to subjective norms. The analysis indicated that AT users had higher subjective norms scores compared to non-AT users. For this reason we reject null Hypothesis 7, that there was no difference in subjective norms between AT users and non-AT users.

There was a significant difference between AT users and non-AT users with respect to control beliefs. The analysis indicated that AT users had lower control beliefs scores compared to non-AT users. For this reason we reject null Hypothesis 8, that there was no difference in control beliefs between AT users and non-AT users.

There appeared a significant difference between AT users and non-AT users with
Results

The analysis indicated that AT users had lower perceived power scores compared to non-AT users. For this reason we reject null Hypothesis 9, that there was no difference in perceived power between AT users and non-AT users.

There appeared a significant difference between AT users and non-AT users with respect to perceived behavioral control. The analysis indicated that AT users had lower perceived behavioral control scores compared to non-AT users. For this reason we reject null Hypothesis 10, that there was no difference in perceived behavioral control between AT users and non-AT users.

There appeared a significant difference between AT users and non-AT users with respect to behavioral intention. The analysis indicated that AT users had higher behavioral intention scores compared to non-AT users. For this reason we reject null Hypothesis 11, that there was no difference in behavioral intention between AT users and non-AT users.

Two regression models were developed to address Hypothesis 12—determining the extent TPB predicted AT use. The first regression model contained only distal TPB constructs independent variable and weekly AT use as the dependent variable. Each of these constructs was a significant predictor in this model: attitude toward the behavior ($p<0.001$), perceived behavioral control ($p=0.018$), and subjective norms ($p<0.001$). The overall fit of the model was significant ($p<0.001$), however the adjusted-$R^2$ was low (0.1158). In other words these three predictors explained 11.6% of the variation in weekly AT use. The assumptions for using linear regression were verified: normally distributed residuals, equal variance and independent cases.

The second model included distal TPB constructs, demographic and other variables
measured as the independent variables, and weekly AT use was the dependent variable. Backwards elimination was used to identify the variables which best explain and predict weekly AT use. Assumptions for linear regression were verified. All predictor variables in the final model were significant at the $\alpha = 0.05$ level. The final model included the following independent variables: perceived behavioral control, subjective norms, transportation type used most frequently, transportation type used for travel to campus, destination when using AT, and age. This full model explained a larger portion of variation in weekly AT use compared to the model only containing TPB constructs ($R^2_{\text{adj}} = 0.5099$).
Chapter 5: Discussion & Conclusions

The purpose of this study was to predict active transportation behavior among University of Cincinnati (UC) students using the Theory of Planned Behavior constructs. This study also analyzed differences between TPB constructs among AT users and non-AT users.

Over three quarters of UC students reported using AT at least one time per week. This rate is much greater than a comparable national estimate for the same age group, 14.1% (Gordon-Larsen, Nelson, & Beam, 2005). This study used data from over 20,000 recent high school graduates to characterize their transportation behavior. Participants were asked about their preferred method of transportation and classified as full or part-time users. For the purpose of this study, comparison values were only used for once-per-week users.

Even in comparison to other estimates for American adults, which vary between 5% and 50% for college-aged persons, UC students still use AT at a greater rate (Babey, Hastert, Huang, & Brown, 2009; Gordon-Larsen, Nelson, & Beam, 2005). The dense urban setting where UC is may be one explanation. Close proximity to destination contributes to the likelihood that students use AT (Sisson & Tudor-Locke, 2008). The University is conveniently located to several amenities for students: grocery stores and markets, restaurants, recreation facilities, cafés, etc. For this reason, the need for students to use or own an automobile may be lower compared to other universities. In this situation, the physical environment may enable students to use AT.
Analysis indicated that all TPB construct scores differed between AT users and non-AT users. Proximal constructs contributing to attitude toward behavior and subjective norms were all higher for AT users. Because these proximal constructs were significantly different between AT user types, their corresponding distal constructs were significantly different as well. AT users possessed higher attitude scores for using AT compared to non-AT users. This suggests that individual attitude is an important precursor to engaging in AT. On the other hand those with a poor attitude toward AT would be inhibited by this attitude for initiating and continuing to engage in AT use.

Those who used AT also had higher subjective norms scores compared to non-AT users. This aligns with and further suggests that social influences play an important role in individual engagement in AT (McArthur & Raedeke, 2009). On the opposite view, social influences can play an inhibitory role, as may be the case with non-AT users having lower subjective norms scores. Whether or not something is perceived as being “normal”, or an accept behavior can be a large social force moving people to use AT or not. At a campus like UC, there are several social and environmental forces acting on students to use AT. First, the campus is located in a densely populated area and many students live nearby. This increases the likelihood that they use AT based on the physical structure of their environment. Also, the atmosphere at the University’s Office of Sustainability promotes environmental stewardship, which influences the culture and norms of the university (UC Sustainability, 2012).

Perceived behavioral control also differed between AT-users and non-AT users. Non-AT users had higher perceived behavioral control compared to AT-users. It appeared
as if those who used AT perceived that they did not have control to use AT or another form of transportation. It is certainly possible that the AT-users surveyed were using AT out of necessity. In other words, they used AT because they didn’t have access to other forms of transportation like a personal automobile. It is more common for underclassman to attend college without having a personal automobile due to the expense of owning a car, parking and/or the requirement to live in on-campus housing.

The distal TPB constructs were used in regression analysis to predict AT use. This analysis yielded an 11.6% explained variation ($r^2$) in weekly AT use. Even though TPB constructs explain some of AT behavior, there clearly are other important variables missing from the prediction model. For this reason, a second model was created with included the distal TPB constructs as well as other variables might be insightful in predicting AT use. The resultant model contained the following variables: perceived behavioral control, subjective norms, where AT is most often used to go, AT use to campus, most common transportation type and age. This model explained 51.0% ($r^2$) of the variation in weekly AT use. This marked increase is to be due to the inclusion of variables that contribute to the explanation of AT use.

This research is may be important to the health promotion and education field because it sheds light on what factors influence the use of AT. It is now better understood which variables explain AT use (or at least 51% of AT use). Field health educators can target programs around these demographics. For example, a field health educator could also use this information to target motorists regarding AT-safety. This study indicates that non-AT users have lower subjective norms. One potential field project could focus on
improving subjective norms among non-AT users in context of increasing safety for AT users; safety being a commonly cited barrier against using AT (Bringolf-Isler et al., 2008).

Opportunities for future research in this area are virtually wide-open. However, future studies that build upon this study should include a focus on identifying and further characterizing important predictors of using AT. Further, AT behavior among non-college adult populations needs to be described in order to fully understand and promote AT among the general public. And, lastly, research that seeks to identify and minimize social norms differences between AT users and non-AT users would be beneficial in reducing stigma related to using AT.

This study has inherent limitations. First, data were collected from a convenience sample of UC students during the Spring, 2012 quarter. Also, those that did respond represent only approximately 4% of the student body. Aside from the survey being distributed to student email accounts, it is unclear what would have caused this large of a non-response rate. Additionally, there may have been online-only or other distance learning student who received and filled out the survey. Another limitation is that no follow-up was performed; only had the single solicitation for recruitment was given. Lastly, it is possible that those who participated in the study were more interested in AT than those who did not take the survey.

In conclusion, a large majority of UC students use AT at least weekly. This behavior is in large measure (51%) influenced by the following factors: subjective norms, perceived behavioral control, transportation type used most and the destination, and age. Theory of Planned Behavior constructs accounted for a notable, but small portion of the explanation.
of AT use (11%).
**References**


References 56


Appendix A: Survey Instrument

ACTIVE TRANSPORTATION* AMONG COLLEGE STUDENTS

DIRECTIONS: This survey is voluntary. Please answer the questions honestly. All of your responses will be confidential and anonymous. There will be no way to link the questionnaire with the respondent. By completing the survey you are granting your consent to participate in this research study.

*Please note that the term Active Transportation refers to getting from one place to another using physical activity, or non-motorized transportation (e.g. bicycling, walking, skateboarding, etc.).

By continuing you are consenting to participate in the study.

DIRECTIONS: Please select one answer only for questions 1 through 10

1. What is your sex?
   a. Male
   b. Female

2. What is your age?
   a. <18
   b. 18
   c. 19
   d. 20
   e. 21
   f. 22
   g. 23
   h. 24
   i. >24

3. What is your class standing?
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Graduate or professional
4. What is your race/ethnicity?
   a. Caucasian
   b. African American
   c. Asian American
   d. Middle Eastern
   e. Latin or South American
   f. Other (please list): ______________

5. How far from campus do you live?
   a. Less than 1 mile
   b. 1-3 miles
   c. 3-5 miles
   d. Greater than 5 miles

6. In the past 7 days, on how many days did you use active transportation?
   a. 0 (Skip to Question 8)
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5
   g. 6
   h. 7

7. What method of active transportation do you use most?
   a. Walking
   b. Bicycling
   c. Skateboarding/Longboarding
   d. Other (please list): ______________

8. What method do you most often use for transportation?
   a. Public transportation (e.g. Metro bus)
   b. Private motorized transportation (e.g. personal car or getting rides from others)
   c. Active transportation

9. What method of transportation do you most often use to travel to campus?
   a. Public transportation (e.g. Metro bus)
   b. Private motorized transportation (e.g. personal car or getting rides from others)
   c. Active transportation
10. What places do you most often go using active transportation?
   a. School
   b. Work
   c. The store
   d. Recreation
   e. I never use active transportation
   f. Other

DIRECTIONS: Please select how strongly you agree or disagree with each statement

<table>
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<tr>
<th></th>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>11.</td>
<td>I carpool when using motorized transportation.</td>
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<td>12.</td>
<td>Active transportation will lead to improved physical activity.</td>
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<td>13.</td>
<td>Active transportation will lead to improved environmental health.</td>
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<td>14.</td>
<td>Active transportation will lead to improved mental health.</td>
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<td>15.</td>
<td>Active transportation will lead to improved weight management.</td>
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<td>16.</td>
<td>I value the contribution of active transportation to improve physical activity</td>
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<td>17.</td>
<td>I value the contribution of active transportation to improve environmental health.</td>
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<td>18.</td>
<td>I value the contribution of active transportation to improve mental health.</td>
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<td>19.</td>
<td>I value the contribution of active transportation to improve weight management.</td>
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<td>20.</td>
<td>I enjoy using active transportation.</td>
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<td>21.</td>
<td>Active transportation is important to me.</td>
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<td>22.</td>
<td>My friends use active transportation.</td>
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<td>Strongly Disagree</td>
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<td>23.</td>
<td>My family uses active transportation.</td>
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<td>24.</td>
<td>My friends support, or would support me using active transportation.</td>
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<td>25.</td>
<td>My family supports, or would support me using active transportation.</td>
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<td>26.</td>
<td>My friends encourage me to use active transportation.</td>
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<td>27.</td>
<td>My family encourages me to use active transportation.</td>
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<td>28.</td>
<td>I tend to align my actions with what my friends do.</td>
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<td>29.</td>
<td>I tend to align my actions with what my family does.</td>
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<td>30.</td>
<td>My friends’ support influences me using active transportation.</td>
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<td>31.</td>
<td>My family’s support influences me using active transportation.</td>
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<td>32.</td>
<td>My friends’ encouragement influences me to use active transportation.</td>
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<td>33.</td>
<td>My family’s encouragement influences me to use active transportation.</td>
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<td>34.</td>
<td>Lack of time keeps me from using active transportation.</td>
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<td>35.</td>
<td>Distance to travel keeps me from using active transportation.</td>
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<td>36.</td>
<td>Road safety (e.g. busy traffic, dangerous intersections) keeps me from using active transportation.</td>
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<td>37.</td>
<td>Personal safety (e.g. getting mugged) keeps me from using active transportation.</td>
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<td>38.</td>
<td>Weather keeps me from using active transportation.</td>
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<td>Lack of interest keeps me from using active transportation.</td>
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<td>40.</td>
<td>It is easy to make time to use active transportation.</td>
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<td>41.</td>
<td>It is easy to overcome distance to use active transportation.</td>
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<td>42.</td>
<td>It is easy to endure weather to use active transportation.</td>
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<td>43.</td>
<td>It is easy to overcome road safety (e.g. busy traffic, dangerous intersections) to use active transportation.</td>
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<td>44.</td>
<td>It is easy to overcome personal safety (e.g. getting mugged) to use active transportation.</td>
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<td>45.</td>
<td>It is easy to overcome lack of interest to use active transportation.</td>
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Appendix B: Cover Letter

Spring, 2012

Dear Student,

I am a graduate student in the Health Promotion and Education program here at the University of Cincinnati and am conducting a research study about student use and perceptions of active transportation. Active transportation is use of any non-motorized means of getting from one place to another, like walking, bicycling, skateboarding, etc. With your participation, light will be shed on an important and relatively unstudied topic with implications pertaining to physical activity and transportation.

Please see below for answers to your questions about this research study and information about participation.

https://www.surveymonkey.com/s/ActiveTransportationUC12

Sincerely,

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